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THE SCIENTIFIC PRINCIPLES OF THE SEVEN-YEAR-CULTIVATION RULE OF THUMB (7-Y-C RoT) IN FARMING MANAGEMENT

by

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Abstract

Underlying the verses describing a prophetic interpretation of an Egyptian King's dream about "seven lean cows devouring seven fat ones and seven dry ears of corn withering around seven green ones" are some principles that remain to be further uncovered in farming research. The relevance of the principles probably lies in the science and economics of farming management. Firstly, seven-year-cultivation period is a basis for many crop production systems, especially in terms of efficiency and major production decisions. Secondly, seven-year-cultivation period is also a basis for analyzing the cyclical nature of many agricultural crops. This paper discusses some examples of agricultural crop systems that demonstrate such characteristics. It is found that the agronomic and economic aspects of crop production are logically tied to the concept of seven-year time horizon and, therefore, it makes sense to strategize farming management on a seven-year cycle basis.

Key words: Seven-year-cultivation rule of thumb (7-Y-C RoT), farming management.

1.0 INTRODUCTION

The prophetic rule of thumb about seven-year-cultivation period (7-Y-C RoT) in farming based on Prophet Yusof's interpretation of an Egyptian King's dream has set some important scientific and economic principles in the agricultural sector since the old times. The principles laid down in the 7-Y-C RoT is recorded in the al-Quran, surah Yusof: verses 43-49 as follows (adapted from Yusof 'Ali):

43. And the King (of Egypt) said: "Verily, I saw (in a dream) seven fat cows whom seven lean ones were devouring - and of seven green ears of grain and (seven) others dry. O notables! Explain to me my dream, if it be that you can interpret dreams."… **47.** [(Yusof] said: "For seven years you shall devote yourself assiduously or steadily* to raising crop as usual and that (the harvest) which you reap you shall leave in ears, (all) - except a little of it which you may eat. **48.** "Then will come after that, seven hard (years), which will devour what you have laid by in advance for them, (all) except a little of that which you have guarded (stored). **49.** "Then thereafter will come a year in which people will have abundant rain and in which they will press (wine and oil)."

* Notes: The word دَأَبَ means persevere in, persist in, devote oneself assiduously or steadily to, apply oneself eagerly to; to work hard, be diligent; to keep doing, keep on, continue to do, do persistently or regularly.

In brief, the above interpretation of dream is as follows: Farmers will sow for seven years diligently whereby there will be seven years of bumper harvest in the country. From the harvests, it is better to store and preserve the required quantity of grain in clusters because, next, there will be a famine lasting for another seven years during which the preserved stores of grain shall be utilized for feeding the famine-struck people and little quantity shall be used for cultivation. Afterwards, there will be a year in which the people shall have heavy rains and bumper crops. They shall press grapes.

These verses underline a number of major scientific principles and/or aspects in farming management. The verses clearly stipulate that the harvest should be stored and preserved for consumption and growing materials. These have set the general principles in farm production and food system management.

Farm production involves, among other things, the major aspects related to rotational farming (applicable to animal production as well); seeds storage/breeding stock; crop and animal breeding while food management involves, among things, the major aspects related to alleviating the effects of agricultural cycle (including buffer stock); production planning; and consumption.

There could a question: what is the wisdom of "seven-year" cultivation strategy? The prophetic 7-Y-C RoT is by no means a decree. It was, in the first place, a "ta`bur" by a prophet who has been divinely inspired by Allah but, then, it was a management strategy that has a great wisdom in it. It sets some general principles on aspects of farming management, especially with regards to crop and animal production, for ensuring a well-managed economy. The main concern of any farming management is to minimize the impacts of environmental uncertainties on the economic and social well-being of a particular country. Thus, the only strategy for minimizing such impacts is proper management of the farming system.

The next section discusses a brief background on ancient Egyptian farming system. This is followed by the background to the quranic interpretation of the verses on the King's dream. Theoretical and empirical discussions on the scientific principles of 7-Y-C RoT are given in the ensuing sections. The last section concludes this paper.

2.0 A BRIEF ACCOUNT ON ANCIENT EGYPTIAN FARMING SYSTEM

Like its modern version, the ancient Egyptian agriculture was largely dependent upon the Nile river system. Throughout the history, the main water source for farming was the Nile. Rainfall was almost non-existent in Egypt, and the Nile has always been the source of water for raising crops and animals (Harris, 2001).The agriculture along the Nile was based on growing winter crops after the annual floods had subsided (Cowen, 2008). However, crops were also grown in other seasons. The principal crops of ancient Egypt included emmer (a type of wheat), barley, and flax (Robinson, 1961; Mellersh, 1962; James, 1979; Romano, 1990). Wheat and barley were the staple food of which bread and beer were made, respectively. Other popular fruits and vegetables in the Egyptian ancient times were dates, figs, grapes peas, beans, and cucumbers.

The people of Egypt have always been working closely with the seasons and understanding their change. Crops used to be harvested three times a year (). This means, many ancient Egyptian farmers used to grow either short-term or mixed crops. Due to the seasonality of groundwater from the Nile river system, the ancient Egyptian farmers have devised a sophisticated irrigation system since 4,000 years ago (Gadalla, 2005; Cowen, 2008).

However, no man's power can overcome Allah Almighty's power. Famine was a critical problem of national importance to the ancient Egyptian farming system whereby the first terrible drought that lasted for seven years nicknamed as Famine Stela was said to have taken place during the reign of Djoser, the Pharoah's third dynasty king (Lichtheim, 1980; Haiying, 1998; Wilkinson, 1999). The place of calamity was believed to be Sehel Island, Aswan, in the southern Egypt. During this time, the Nile was said to have not flooded the nearby lands for years. Because of their obstinence and rejection of Allah as the only God to be worshipped, Allah sent various disasters upon Pharaoh and his subjects. The abovementioned period of extreme drought in Egypt was one of these. This occurred as a lesson to Pharaoh and his subjects as mentioned in the al-Quran:

"We seized Pharaoh's people with years of drought and scarcity of fruits so that hopefully they would pay heed" (al-'Araaf: 130).

It was recorded in the Egyptian history that the 7-year good harvest and 7-year famine did really occurred long before Prophet Yusof's interpretation of the King's dream. The water level of the Nile fell tremendously and the country was hit by a severe drought. Since water was terribly crucial for the Egyptians, the drought directly threatening their very livelihood. Agricultural products diminished in availability and famine ensued. However, there were no reliable records as to how many times draught has struck the ancient Egypt.

Some accounts mentioned that a severe famine struck the ancient Egypt again during the King's rule at a time before Prophet Yusof's was born. At the Prophet Yusof's adulthood time, however, by Allah's leave and due to Prophet Yusof's divine foresight and planning, the calamity did not take place. The country did not face a shortage of food. During the first seven years of famine he supplied grain to the people according to their minimum needs and stored the rest in the newly-built granaries. By the time the seven good years were over, the granaries were full. With the Prophet's Yusof's wisdom, the years of famine have been salvaged through a well-managed system of farming (including seed storage) and food consumption management.

Prophet Yusuf was then made a minister in charge of, among other things, finance and agriculture. One of his agricultural and food management strategies was to make a brief tour of Egypt to assess the best locations where intensive cultivation could be carried out. He allocated extra money to the farmers in the most fertile areas of the Nile so that they would be able to grow the maximum amount of grain. He also ordered the construction of huge storehouses (granaries), capable of storing several hundred tons of the surplus grain.

3.0 BACKGROUND TO THE QURANIC INTERPRETATION OF VERSES

Although there are slight differences in the use of terminologies in interpreting surah Yusof verses 43-49 among the scholars, their *ijmaali* interpretation does not deviate very much from each other. For example al-Tabari and al-Ghurnathi give the following interpretations.

Table 1: Comparative interpretations of verses

Interpreter	Quranic key words	Interpretation
Al-Tabari (d. 310 H) الطبري	السمان من البقر (Fat cows)	السنون المخصبة (Years of fertility)
	السمان (The fat)	المخاصيب (The fertile)
	السبع العِجاف (Seven lean)	سنون مجدبة لا تنبت شيئاً (Years of infertility no crop at all)
	البقرات العجاف (Lean cows)	السنون المُحُول الجُدُوب (Years of draught and infertility)
	الخضر (The green)	السنون المخاصيب (The fertile years)
	اليابسات (Dry out)	الجُدُوب المحول (The infertile, the draught)
Jazii al-Ghurnaathi (d. 741 H) جزي الغرناطي	بقرات سمان "Fat cows"	مُخْصِبَةٌ (Fertile, fruitful, productive)
	العِجاف البقرات "Lean cows"	مُجْدِبَةٌ (Infertile, fruitless, unproductive)
		سبع بقرات (Seven years)

Based on the interpretation of Jazii al-Ghurnaathai (d. 741 H), the words "seven fat cows" mean cows that became fat for seven years and "seven lean cows" mean cows that became thin for seven years. Based on some clues in verse 46, scholars have concluded that the "fat" and "lean" conditions of these cows occurred at different time periods. This means, the verses refer to different time periods of fertility (or productivity) and infertility (or unproductivity). For example, Jazii al-Ghurnaathii mentioned (Jazii):

فعلمهم حيلة يبقى بها من السنين المخصبة إلى السنين المجدبة

(*So, he taught them a strategy whereby they survive during years of fertility as well as years of infertility*)

Prophet Yusof's interpretation of the King's dream points to at least two main phenomena of the physical world: cyclic nature of the environment (and, thus, agricultural production) and strategies to alleviate the impact of the changing environment in terms of good farming and food system management.

4.0 BASIC PRINCIPLES OF 7-Y-C RoT IN FARMING

The keywords seven years may not necessarily mean exactly seven years. It can mean "within" or "in the region" or "plus-minus" seven years. It may also mean a "medium-term" period during which some important farming strategies and decisions should be made. These approximations could be true perhaps in light of the Egyptian farming of the time at which Prophet Yusof passed his divine recommendations to the King. Nevertheless, the "seven-year" mythical principles can be broadly applied to the modern farming management in many ways. Discussion follows.

4.1 Agronomic Aspects

In general, agricultural crops can be divided into short-term (e.g. arable) and long-term (perennial) crops. Irrespective of their life structure, one important goal of agronomic practices is to protect soil resources (e.g. maintaining soil's biological quality) and improving production potential (e.g. best crop combination and cultivation system).

For short-term crops, seven-year rotation system is a common practice in many parts of the world. However, this depends, among other things, on the nature agricultural system practiced and the climate of the country. Table 2 shows an example of crop systems practised in some countries.

Table 2: Example of Seven-Year Arable Crop Systems

	Country	Type of farming	Example of general crop rotation system
1.	Former Soviet Union in general [1]	Arable	System 1 (5-year): W-W-B-O-F System 2 (6-year): Option 1 W-W-W-B-B-F Option 2 W-W-W-B-O-F Option 3 W-W-W-O-O-F System 3 (7-year): W-W-W-W-B-O-F
2.	Ukraine [2]	Arable	System 1 (6-year): F-W-W-S-B-C
3.	United States	Arable	Various systems (5-7 years)
	United Kingdom (Pfiffner et al., 1993)	Arable	System 1 (7-year): Bt-Bt-Bt-Bt-Bt-Bt-Bt

Notes: B = barley; Bt = beetroot; C = corn; F = fallow; O = oat; S = sunflower; W = wheat

In the case of organic farming, successful organic production begins with crop rotation to break up cycles of weeds, pests and diseases. Fairly simple rotation guidelines can be followed, for example, by selecting three crop rotation elements over a seven-year period without using the same element consecutively (Goforth, 2008). This means, there are fallows in between the years.

The right combination of rotation systems can be part of farming success (Pfiffner et al., 1993; Bowman, 2002). For example, a farmer with 25 years of farming experience in the U.S. used a typical seven-year rotation in planting an over-wintering rye cover crop followed by soybeans; a fall-planted small grain; a legume/grass mix "frost-seeded" into the grain in late winter; several years of hay or pasture; corn; another rye cover-soybeans sequence; cereal grain frost-seeded with a legume/grass mix; finishing with a fallow year when the forage mix growth is clipped but left to replenish soil organic matter. The seventh year's "crop" was found to be an enrichment and regeneration of soil biological life. The soil benefits which improved and protect succeeding crops easily offset the opportunity cost plus clipping and $20 per acre in taxes. A late seeding of buckwheat for grain in the seventh summer and then a fall seeding of rye to restart the rotation combine to provide a needed break in the legume cycle that has prevented a buildup of soil disease organisms. In Russia, cultivation of 7 types of a seven-year crop rotation system of fodder crops produced the highest yield (average of 10.92 t/ha) and the best humus balance (+2.31 t/ha) when using crop rotations of pea, barley, and grasses; lucerne and grasses; winter rye and sorghum, and maize (Stupakov et al., 2001).

Yield response needs sufficient time to show even in short-term cash crops. Although there is no hard-and-fast rule for assessing crop performance, a seven-year period is commonly perceived to be a reasonably sufficient duration for observing yield response to manuring and other treatments. For example, wheat grain yield responds to nitrogen rates in the first five while to potassium rates in the first two years of seven years of growth. Grain nitrogen content can be affected in six of seven years of growth (Girma et al., 2006). The effect of organic farming on the production of crops under a mixed organic system, a stockless all arable farming system, and a horticultural enterprise was assessed over the first seven-year experiment with a potential for a further experiment over the second seven-year phase (Leake, 1999; CWS Farms Group, 2002). In some farming research such as the livestock production, a period of five to seven years is considered sufficiently long enough to produce reliable field results on breeding and/or feeding (Dwayne Rohweder and Ken Albrecht).

Yield reduction due to soil compaction can reach a substantial proportion in a period of seven years. For example, in Ohio, reductions in crop yields are 25% in maize, 20% in soybeans, and 30% in oats over a seven-year period (Lal, 1996). Remedial agronomic practices are needed after such a period to prevent further loss of crop output. In another context, a complete nutrient recycling in arable crops occurs in seven year and with rotational cropping, this cycle may be somewhat modified.

Some aspects of farm husbandry such as pest and disease control take just enough time make an impact. In the case of citrus farming, for example canker takes a farmer a seven-year trip before he can start making money again. It includes two years' worth of quarantine on the land and five years before the farmer can start getting any real production off those trees. So, there are about seven years' worth of no cash income at all. [3]

4.2 Farm Economics

Crop production optimisation strategy normally necessitates calculation of short-term or medium-term profit from a particular enterprise. For instance, whether one could recoup capital investments within the seven-year period needed to depreciate them (Thompson, 1997). In agricultural property valuation, the concept of seven-year profit capitalisation has been accepted by the court as a basis for estimating the value of rubber plantation. Such a principle may have some economic basis since long-term investments such as those in perennial crop and livestock have some components of medium-term income and profit profiles, during which important production decisions need to be known. For instance, some long-term crops such as oil palm and rubber have a span of productive age of about 20 years, which is divided into three production stages whereby the outputs follow the law of diminishing returns (Figure 1). Stage I is an irrational stage at which there tends to be under-employment of input. Stage II, at which there is full employment of inputs, is a rational stage. Stage III is again an irrational stage for a different reason, i.e. over-employment of input. On average, the length of each stage is about seven years.

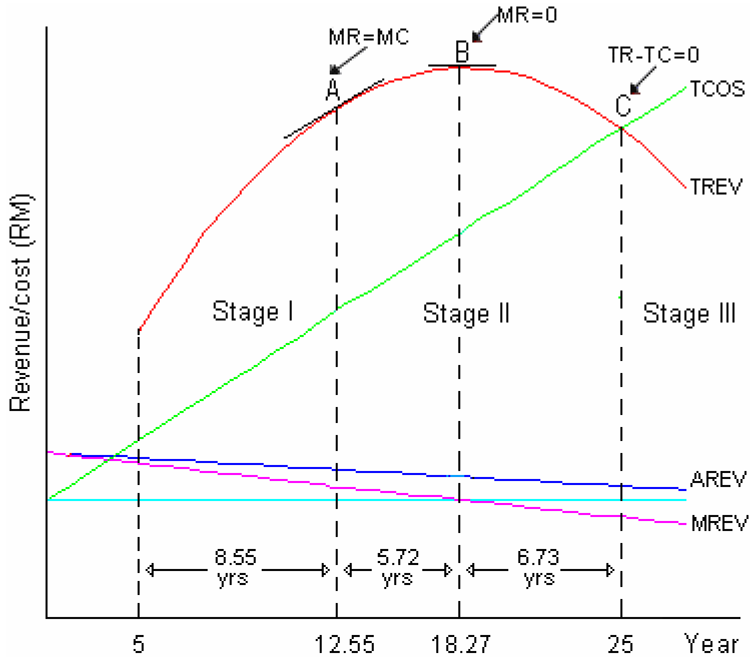

Figure 1: Principles of production efficiency
(Notes: Figures at the bottom are based on the study case – Bukit Lawiang oil plam plantation)

These stages also reflect three important production events. The terminal point of Stage I is characterized by maximum profit is at A; the point of maximum revenue at B; while the point of terminal productive cycle at C. Each stage can have a time-span of around 7 years.

Study Case

To illustrate the above three events, a study case was chosen, namely the Tabung Haji oil palm plantation at Bukit Lawiang, Kluang, Johor. A summary of production area is shown in Table 3 while the basic production profile is shown in Table 4.

Table 3: Production area of Tabung Haji oil palm plantation, Bukit Lawiang, Kluang, Johor

Block	Planted year	Area (ha.)
PM 82A	1982	219
PM 83B	1993	356
PM 84A	1984	334
PM 84B	1984	282
PM 84C	1984	269
PM 84D	1984	296
PM 85A	1985	105
PM 85B	1985	128
Building/office/quarters		12
Hilly forest/vacant land		13
Total		2,014

Using the data in columns 2 and 4 of Table 4, a production prediction curve was estimated as FFB = 6.205 + 2.0548*year - 0.0622*year^2 where year represents the age of oil palm trees from field transplanting. Based on output mean differential adjustment technique (Hamid, 2000) the equation was used to further predict the FFB production for years 16 through 28. It was then multiplied by price of FFB per ton to obtain total revenue curve. Two essential production functions were then estimated as follows:

Table 4: Production data of Tabung Haji oil palm plantation, Bukit Lawiang, Kluang, Johor

Year	Age (Year)	Total output (ton FFB)	FFB/ha (ton)	FFB price (RM/ton)	Production cost (RM/ton)
1990	5	33,593.22	16.89	120.49	77.72
1991	6	36,057.28	18.13	157.01	85.00
1992	7	40,956.37	20.59	184.07	82.62
1993	8	45,142.11	22.70	170.77	80.26
1994	9	38,142.00	19.18	270.77	105.3
1995	10	40,207.59	20.21	286.41	107.54
1996	11	45,581.18	22.92	234.24	113.95
1997	12	43,334.00	21.79	210.00	95.00
1998	13	41,900.00	21.07	210.00	93.00
1999	14	46,000.00	23.13	210.00	90.00
2000	15	42,000.00	21.12	210.00	92.00

Note: FFB = fresh fruit bunch.

$$TREV = 0.771785 + 798.035*YEAR - 21.84*YEAR^2 \quad (1)$$
$$TCOS = 250*YEAR \quad (2)$$

where TREV = total revenue and TCOS = total cost.

Using equations (1) and (2) above, three fundamental aspects of production decisions in oil palm cultivation can be analysed (see Figure 2). Firstly, the point at which profit is the highest, i.e. the point is when MR = MC, i.e. at point A. Secondly, age of maximum yield is achieved when MR = d(TREV)/d(Year) = 0, i.e. at point B. With the production function given, this point can be ascertained by mathematical differentiation of the function. Thirdly, age at which replanting is needed is when profit is equals zero, i.e. at point C.

(a) Age of highest profit

$MR = d(TREV)/d(YEAR) = 798.035 - 43.68*YEAR$.
$MC = d(TCOS)/d(YEAR) = 250$
At point A, MR = MC. Thus, $798.035 - 43.68*YEAR = 250$
$\therefore YEAR = (798.035 – 250)/43.68 = 12.55$

(b) Age of maximum revenue

$TREV = 0.771785 + 798.035*YEAR - 21.84*YEAR^2$
$d(TREV)/d(Year) = 798.035 - 43.68*YEAR$
At point B, $MR = d(TREV)/d(Year) = 0$. Thus,
$\therefore YEAR = 798.035/43.68 = 18.27$

(c) Age of replanting

$\pi = TREV - TCOS = 0$
$= 0.771785 + 798.035*YEAR - 21.84*YEAR^2 - 250*YEAR = 0$
$= (548.035 - 21.84*YEAR)*YEAR = -0.771785$

The logical solution is $548.035 - 21.84*YEAR = -0.771785$
$\therefore YEAR = 548.806786/21.84 = 25$

The summary of the above calculation is shown in Table 5.

Table 5: Three important production events in oil plam

Production stage	Criteria	Remarks
Point of maximum profit	When MR = MC (where MC = 250) Calculation: Year = 12.6	Achieved after about 9 years from first production (3.5 years of age)
Point of maximum revenue	When MR = 0 Calculation: Year = 18.3	Achieved about 6 years after age of maximum profit
Point of terminal production	When TREV - TCOS = 0 Calculation: Year = 25	Achieved about 7 years after age of maximum revenue

From Table 5, it can be said that the 7-Y-C RoT is useful in the production planning of long-term crop. For such a crop, the manager should embark on an efficient approach to produce the highest profit within seven years after the first year of FFB production. From this point, he knows that production rate is going to decline whereby the rate will reduce to zero when the production reaches the maximum level of revenue over the next seven years. The final seven years is a period that prepares the manager for a replanting scheme.

BASIC PRINCIPLES OF "SEVEN-YEAR" PERIOD IN FOOD MANAGEMENT

UNDERSTANDING CYCLES

One important aspect of 7-Y-C RoT is related to seasonal fluctuation in agricultural production and output price or simply called agricultural cycle. This cycle is reflected in the successions of good period and abundant yields or favourable prices (period 1); followed by dry period, bad growth, bad harvest, famine, and unfavourable product prices (period 2); and finally rainy period, good growth, good harvest, abundant yields, and favourable product prices again (period 1). This cycle is illustrated in Figure 2.

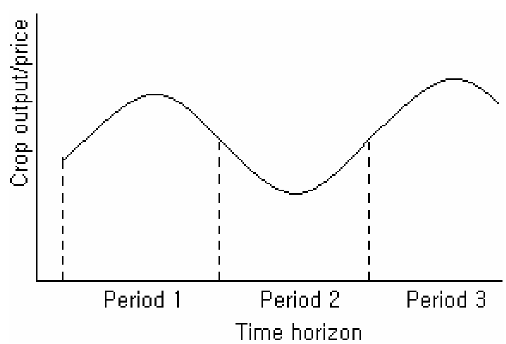

Figure 2: The concept of cycle

Agricultural cycle can last for a few, say five to seven years. Examples of such a phenomenon were 5-year production cycle starting in 2000 in China (China Daily, 7/3/2008); seven-year downward trend in wheat production starting in 1998 in the U.S. (USDA, 2004a, 2004b). The El Niño that affects agricultural production can develop every 4 to 7 years (Strock and Everett, 2002). Output price cycles in some crops such oil palm and soya bean have an average cycle length of seven years (Figure 3).

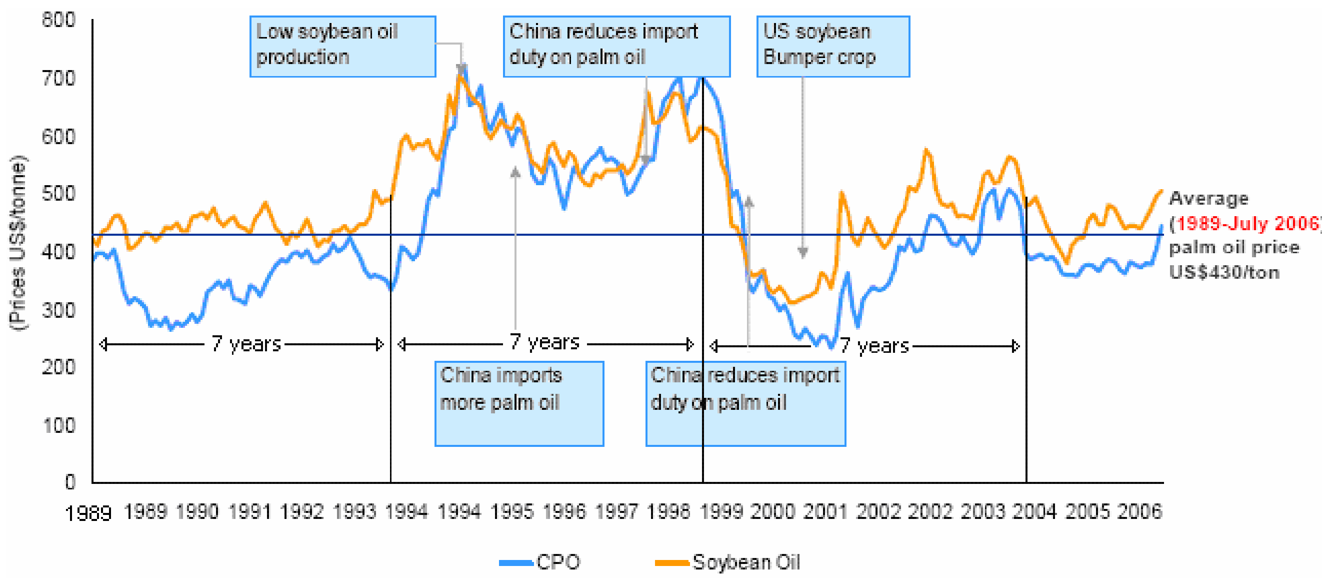

Figure 3: Price fluctuation in crude palm oil (CPO) and soya bean oil (source: PT SMART Tbk, 2006)

One of the challenges as a result of agricultural cycles is to stabilize production and/or price. As shown in Figure 3, both oil palm and soya ben faced a tremendous pressure to increase their market prices during the periods of 1989-1990, 1994-1996, 1999-2001, and 2003-2005. Therefore, it is crucial to understand such changes and to put up farming strategy during such periods. Indeed, this is a difficult task.

One widely adopted agricultural risk stabilizing strategy is agricultural contract scheme. In this context, seven-year contract schemes in agricultural subsidies have become the common ground in many countries, especially to alleviate the impacts of production and price risks since producers normally rely totally on the marketplace. USDA's Risk Management Agency, for instance, has an agricultural support scheme whereby producers receive fixed payments over a seven-year period, on a declining basis (Kintzle, 2005).

FOOD SUSTAINABILITY

Food production has the fundamental function of providing necessary nutrition to the society permanently. In order to achieve this goal, agricultural sustainability is a must. This needs a well-managed farming system. Among other things, the key food sustainability strategy is well-managed food production, consumption, and stock systems. This, in turn, requires a thorough understanding of life cycle stages of the food system. Life cycle assessment (LCA) is an analytical method used to evaluate the resource consumption and environmental burdens associated with a product, process, or activity. In agriculture, food LCA uses indicators that address economic, social, and environmental aspects of each life cycle stage: origin of (genetic) resource, agricultural growing and production, food processing, packaging and distribution, preparation and consumption, and end of life (Heller and Keoleian, 2000).

The basic principle of this has been laid down by Prophet Yusof himself. Firstly, he recommended continuous food production through seven good years or cultivation. Secondly, he recommended grain storage for seeds propagation. Thirdly, he allocated the budget for agricultural production and building storage and processing facilities. Fourthly, during the following seven famine years, he allocated the amount of stored grains to the Egyptian people according to per capita minimum requirement. This way, he managed to avoid starvation and control the prices of grains. Prophet Yusof's approach to providing grain storage has set the principle in the use of buffer stock for many commodities in the modern world's economies as a strategy of facing production and economic cycles. Rubber, cocoa, etc. are examples of such commodities. The concept was then broadened to include processed foodstuff. For example, as a result of shortage of supply and rising prices Malaysia has made a move by creating buffer stock for controlled consumer food items such as sugar, cooking oil, and flour in 2008. It has done so for rice in the 1960s.

One very crucial aspect of food sustainability, as taught by Prophet Yusof, is food production planning. The main objective is to ensure food sufficiency through farm production. We may have wondered how he has planned crop cultivation for a 14-year period to ensure food security. The principle lies in the sustainability mentioned above. A simple example of cultivation planning is as follows:

$$Od = Cd \times Sf \times Dt \times Pt \qquad [\text{where } P_o(1 + g)^n] \qquad (3)$$

$$Rr = Od/[Fd \times (1 – Fl)] \qquad (4)$$

$$Ac = Rr/Og \qquad (5)$$

where Od = minimum annual dry-weight-equivalent dietary (ADWED) needs of the population; Cd = minimum daily per capita per serving dietary needs of a particular type of grain crop; Sf = frequency of daily intake of that grain food; Dt = number of days of annual consumption of that grain type; Pt = population size in a particular year; Po = population size in the base year; g = population's annual net growth (%);n = number of years of growth; Rr = minimum required annual fresh-weight grain (AFWeG) production (metric ton); Fd = dry food content conversion factor (per tonnage basis); Fl = processing & marketing inefficiency factor (per tonnage basis); Ac = total minimum annual area of cultivation (AAoC) needed (ha.); and Og = potential grain production (metric ton/ha.).

Let say Po = 100,000; g = 2%; t = 7; Cd = 0.2 kg; Sf = 2; Dt = 365; Og = 35 metric tons/ha.; Fd = 0.45; and Fl = 0.15. The solutions for the above models are tabulated as follows:

Table 6: Hypothetical example of grain production functions

Year	Population	Minimum ADWED needs (metric ton)	Minimum AFWeG production (metric ton)	Total minimum AAoC needed (ha.)
0	100,000	14,600.00	38,169.93	1,090.57
1	102,000	14,892.00	38,933.33	1,112.38
2	104,040	15,189.84	39,712.00	1,134.63
3	106,121	15,493.64	40,506.24	1,157.32
4	108,243	15,803.51	41,316.36	1,180.47
5	110,408	16,119.58	42,142.69	1,204.08
6	112,616	16,441.97	42,985.55	1,228.16
Total		108,540.54	283,766.11	8,107.60
Average	106,204	27,135.13	70,941.53	2,026.90

Table 7: Hypothetical example of grain production planning

Year	Minimum AFWeG production (metric ton)		Total minimum AAoC needed (ha.)	
	Current	Future	Current	Future
0	38,169.93	-	1,090.57	-
1	38,933.33	-	1,112.38	-
2	39,712.00	-	1,134.63	-
3	40,506.24	-	1,157.32	-
4	41,316.36	-	1,180.47	2,702.53
5	42,142.69	141,883.06	1,204.08	2,702.53
6	42,985.55	141,883.06	1,228.16	2,702.53

Since the first “good” seven years should be planned to provide a buffer stock for the next “bad” seven years, the minimum AFWeG production at the end of the first seven years should be twice the total AFWeG figure (row 9, column 4) in Table 6. In the same way, the total minimum AAoC needed at the end of the first seven years should be twice the total AAoC figure (row 9, column 5) in Table 6. In general, the total area of cultivated land should be doubled beginning from the fifth of the first seven years while crop output should be doubled beginning from the sixth and seventh years.

IMPLICATIONS OF THE 7-Y-C ROT

A question that perhaps worth pondering is: do we need to change our farming management strategy from a five-year to a seven-year basis? This paper does not provide the answer for the question since it did not carry out a comparative analysis of farming management in that way. Nevertheless, there is reason to believe that resource use and production optimality may be best achieved over a seven-year period. Therefore, there can be an opportunity to strategize the management of agricultural sector on a seven-year basis to achieve such optimality.

Russia has ever done this a long time before (Rutland, 1985). Korea has also done this whereby together with its First Six-Year Plan (1971-76), the Second Seven-Year Plan (1978-84) and Third Seven-Year Plan (1985-1992) have, among other things, aimed at the improvement of rural living conditions and rural infrastructure; expansion of food grain production to achieve self-sufficiency; development of land and water resources to protect farmers from unfavorable climatic conditions; accelerated farm mechanization so as to free farm workers from heavy manual labor (1998; 1999).

CONCLUSION

The 7-Y-C RoT was a prophetic interpretation of a dream that took a place thousands of years ago. It was then repeated in the al-Qur’an through a story in surah Yusof. Since al-Qur’an is a miracle, there must be a great wisdom behind the event. This paper has discussed the basic principles underlying 7-Y-C RoT in farming management. Although the discussion is far from conclusive, there is some reason to believe that 7-Y-C RoT has some scientific rationales for farming practices. Among other things, there is evidence to believe that various aspects in farming changes crucially over a seven-year period. In other words, seven-year period can be said to be a crucial period during which agricultural phenomena change.

REFERENCES

[1]
http://www.altafsir.com/Tafasir.asp?tMadhNo=0&tTafsirNo=1&tSoraNo=12&tAyahNo=45&tDisplay=yes&Page=3&Size=1

[2]
http://www.fas.usda.gov/pecad/highlights/2004/12/Ukraine%20Ag%20Overview/index.htm

[3]
http://www.marketwatch.com/news/story/Story.aspx?guid={5E1ED83A-F5D9-4232-BC35-796E7580FC82}&siteId=mktw

Al-Tabari (d. 304). Tafseer Jami’ fi Tafseer al-Qur’an/Al-Tabari musonnaf wa mudakkaq.
Bowman, G. (2002). *Steel in the Field: A Farmer’s Guide to Weed Management Tools.* Handbook Series Book 2. Sustainable Agriculture Research and Education Program of CSREES, U.S. Department of Agriculture. Beltsville, Maryland 20705: Sustainable Agriculture Network.

China Daily, China's grain production ends a 5-year slide7th. March 2008.

Cowen, R. (2008). *Exploiting the Earth*, Draft manuscript. Chapter 17. Baltimore, Maryland: The Johns Hopkins University Press. On-line version can be accessed at: http://www.geology.ucdavis.edu/~cowen/~GEL115/index.html

CWS Farms Group (2002). Organic Farming -- Experiments 1989-1997: A Summary of Key Findings. http://www.pmac.net/focus_on_practice.html. Accessed on Thursday, 6/3/2008.

Dawani, A. A. (2005). Potraits *of Youths: In Quran and the History of Islam*. Translated by: Sayyid Athar Husain S.H. Rizvi. Qum, Iran: Ansariyan Publications.

Gadalla, M. (2005). *Ancient Egyptian Culture Revealed*. Greensboro, North Carolina: Tehuti Research Foundation.

Girma, K., Freeman, K.W., Teal, R.K., Arnall, D.B., Tubana, B., Holtz, S., and Raun, W.R. (2006).Temporal Variability Overrides Nitrogen and Phosphorus Nutrient Response.

Goforth, A. (2008). No pesticides? No fertilizer? No problem. Organic farmers turn to alternative solutions. *One Grower Publishing, Llc: Rice Farming*. http://www.ricefarming.com/Home/2003_DecOrganic.html#Top. Accessed on Thursday, 6/3/2008.

Hamid, Abdul, bin Hj. Mar Iman (2000). *Introduction to Agriculture Studies for Property Students*. Unpublished teaching monograph. Faculty of Engineering and Geoinformation Sciece, Universiti Teknologi Malaysia.

Harris, C. C. (2001). Ancient Egyptian Agriculture. *Tour Egypt Monthly: An On-Line Magazine*. Volume II, Number 7 (July 1st).

Haiying, Y. (1998). The Famine Stela: A Source-Critical Approach and Historical-Comparative Perspective. In Christopher John Eyre (eds.): *Proceedings of the Seventh International Congress of Egyptologists; Cambridge, 3–9 September 1995*. Leuven: Uitgeverij Peeters, pp.515–521.

Heller, M. C. and Keoleian ,G. A. (2000). *Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System*. Center for Sustainable Systems School of Natural Resources and Environment, University of Michigan Ann Arbor, MI, Report No. CSS00-04, December 6.

James, T.G.H. (1979). *An Introduction to Ancient Egypt*. NewYork: Harper & Row.

Jazii al-Ghurnaathii (d. 741 H). Tafsiir al-Tashiil li-'ulum al-tanziil/Ibn Jazii al-Ghurnaathii musonnaf wa mudakkaq. http://www.altafsir.com/Tafasir.asp?tMadhNo=2&tTafsirNo=88&tSoraNo=12&tAyahNo=45&tDisplay=yes&UserProfile=0

Kim, Woon-Keun (1999). The Agricultural Situation of North. Research Director, Center for North Korea Agriculture, Korea Rural Economic Institute 4-102, Hoigi-Dong, Dongdaemun-Ku, Seoul 130-710, Korea, 1999-09-01. PDF version downloadable at http://www.agnet.org/library/eb/475/

Kim, Woon-Keun (1998). Food Situation and Agricultural Reform in North Korea. *Journal of Rural Development*, Korea Rural Economic Institute, 10.

Kintzle, J. (2005). http://www.rma.usda.gov/training/trainer/kintzle.html

LAL, R. 1996. Axle load and tillage effects on soil degradation and rehabilitation in Western Nigeria. I. Soil physical and hydrological properties. *Land Degradation Review,* 7, 19–45.

Leake, A.R. (1999). A report of the CWS Agriculture's organic farming experiments. *Journal of RASE*, 160, 73-81

Lichtheim, M. (1980). *Ancient Egyptian Literature*, vol.3, California: The University of California Press, pp.95f.

Magdoff, F. and van Es, H. (2000).*Building Soils for Better Crops*. 2nd. Ed. Baltimore Avenue, Beltsville, MD: Sustainable Agriculture Network (SAN).

Mellersh, H.E. (1962). Finding Out About Ancient Egypt. New York: Lothrop.
Robinson, C. A. Jr. (1961). *The First Book of Ancient Egypt*. New York: Franklin Watts, Inc.

Pfiffner, L., Niggli, U., Velimirov, A., Boltzmann, L., Balzer, U., Balzer, F. and Besson, J.-.M. (1993). Effect of Three Farming Systems (Bio-dynamic, bio-organic, conventional) on Yield and Quality of Beetroot (Beta Vulgaris L. Var. Esculenata L.) in a Seven-Year Crop Rotation, *Acta Hort. (ISHS)* 339:11-32.

PT SMART Tbk (2006). *Company Presentation*. Jakarta, Indonesia. A publicly listed palm oil player in Jakarta & Surabaya Stock Exchange.

Rohweder, D. and Albrecht, K. (2006). Pastures have prominent place in UW-Madison Agronomy history. UW-Madison; excerpts from University of Wisconsin Agronomy Department—The First 100 Years, *Grass Clippings: pasture research you can use*, 1(2) November. http://www.cias.wisc.edu/pdf/pasturenews1106.pdf

Romano, J. F. (1990). *Daily Life of the Ancient Egyptians*. Pittsburgh: Carnegie Museum of Natural History.

Rutland, R. (1985). *The Myth of the Plan: Lessons of Soviet Planning Experience*. London: Hutchinson.

Strock, J. S. and Everett, L. (2002). *Proceedings of the First Agricultural Drainage Field Day*. University of Minnesota Southwest Research and Outreach Center. Lamberton, Minnesota.

Stupakov, I. A., Gerasimenko, L. A., and Merkulova, T. N. (2001). Fodder crop rotation systems are the foundation of forage reserve, *Kormoproizvodstvo,* 12: 9-14.

Thompson, P. B. (1997). Sustainability as a Norm. *Philosophy and Technology*, 2(2) Winter: 75-94.

Wilkinson, T. (1999). *Early Dynastic Egypt, Routledge*, Routledge, pp.83 & 95

USDA (United State Department of Agriculture) (2004a). *World Agricultural Production*. Production Estimates and Crop Assessment Division, Foreign Agricultural Service, Circular Series WAP 05-04 May 2.

USDA (United States Department of Agriculture) (2004b). Crop Production in the Spring Wheat Region of the Former Soviet Union. Production Estimates and Crop Assessment Division Foreign Agricultural Service. Foreign Agricultural Service. Accessed from
http://www.fas.usda.gov/remote/soviet/country_page/fsueast_text.htm on 3/3/2008.

USDA's Foreign Agricultural Service:
http://www.fas.usda.gov/

Genral internet materials on fafseer of al-qur'aan:

http://www.altafsir.com/